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ORIGINAL ARTICLE

Axial external fixator in humerus shaft fractures

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Abstract

The causes of humeral shaft fractures are mostly high-energy traumas such as falling, hitting, traffic accident, and gunshot wounds. It may also occur as a result of simple falls due to osteoporosis in elderly patients. In surgical treatment, there are options such as intramedullary nail, plate-screw fixation and external fixator treatment. External Fixator Treatment it is the primary treatment option for soft tissue damage, open fractures, gunshot wounds, segmental bone loss, pseudoarthrosis, nonunion, and major vascular injuries. The purpose of the present study was to present the functional results of Axial External Fixator Treatment, which we often apply in humerus shaft fractures in our clinic. A total of 30 patients, who had gunshot wounds, multisystem injuries, open fractures, and advanced age comorbid problems, and who underwent Axial External Fixator Treatment due to humerus shaft fracture between January 2016 and January 2019 were included in the study. Disabilities of the Arm, Shoulder, and Hand (DASH) scores were used in clinical evaluations. Visual Analogue Scale (VAS) was used to evaluate the pain intensity in patients subjectively. Also, the results of patients with advanced age comorbid problems were compared with other patients. After a 12-month follow-up, significant improvements were detected in DASH scores. Although fracture union was later in patients with advanced age comorbid problems than in other patients, no differences were detected between union rates, clinical outcomes, and the surgical processes.We think that it is a more appropriate surgical technique than other surgical methods, due to its shorter surgical time and less invasiveness in patients with advanced age, high comorbidity and multisystem damage.

Keywords: Humerus, fracture, axial fixator, fixation

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Introduction

Humerus fractures are detected at an average rate of 6.9% in Türkiye [1]. Proximal humerus fractures are most commonly detected, and the less detected fractures are in the shaft area. These fractures are more common in high-energy trauma in younger patients. It can be seen in elderly patients as a result of simple falls [2]. Conservative treatments yield successful results in most cases and surgical methods are required in some patients [3]. Surgical treatment is usually performed when there are open fractures, unstable fractures, pathological fractures, fractures resistant to conservative treatment, multiple trauma patients, floating shoulder or elbow, bilateral fractures, progressive deficits of the radial nerve, brachial plexus problems, and vascular injuries [3]. There are options, such as intramedullary nail, plaque-screw fixation, and external fixator treatment in surgical treatment. The surgical treatment option in humerus shaft fractures varies according to the age, bone quality, condition of fracture, mechanism of occurrence, and to the presence of injuries in the surrounding soft tissue in patients.

External Fixator Treatment is one of the bedside treatment modalities for humerus fractures. It is the primary treatment option when there is soft tissue damage, open fractures, gunshot wounds, segmental bone losses, pseudoarthrosis, non-union, and significant vascular injuries [4,5]. The aim of our study is to present the functional results of patients who underwent Axial External Fixator Therapy for humeral shaft fractures in our clinic.

Materials and Methods

The study received ethical committee approval from Turgut Özal University Clinical Research Ethics Committee (2021/16). Our study was planned retrospectively. A total of 30 patients treated between January 2016 and January 2019 for humerus shaft fractures were included in the study.

Inclusion criterias

- Patients between the ages of 25 and 90
- Humerus shaft fracture
- Minimum follow-up period is 24 months.

Exclusion criteria

- Pregnancy

Surgical method

When the anesthesia, patient preparation stages, fracture reduction, and sequencing control were achieved, considering the stabilization and the distance of the radial nerve to the fracture area, two or three 3-mm pins were sent with drills to the proximal area of the axillary nerve and to the distal area of the radial nerve accompanied by scope. The surgery was terminated after controlling the reduction, bone sequencing, and stabilization with scope.

Post-operative evaluation

Clinical evaluation was performed in postoperative 2nd year by the same observer. Active elbow range of motion (ROM) was measured using a standard goniometer. Flexion, extension, internal and external rotation angles were recorded. Functional evaluation was performed with Disability of the Arm, Shoulder and Hand (DASH) Score, according to which patients were given scores between 0 (no obstacles) and 100 (maximum injury). Visual Analogue Scale (VAS) was used to evaluate the pain intensity in patients subjectively (scores 0 = no pain and 10 = worst possible pain). Postoperative complications and revision surgeries were recorded and compared.

Statistical Analysis

The IBM SPSS 19 Program was used in statistical analyses (IBM SPSS Statistics 19, SPSS Inc., an IBM Co., Somers, NY). Clinical data were expressed as numbers, percentages, or Mean ± SD. Two-way Chi-Square ($\chi 2$) test was used to evaluate the relationships between two categorical variables. Student's t test was used for continuous variables. $p \leq 0.05$ was considered statistically significant.

Results

Thirty patients treated with external fixator were included in our study. Demographic data of the patients are given in Table 1.

Significant improvements were detected in DASH score after 12 months of follow-up. Union was achieved in patients in an average of 13.7 weeks. Although fracture union was later in patients with advanced age comorbid problems than in other patients, no differences were detected between union rates, clinical results and the surgical processes; and 86.7% of these patients had bone union. There was superficial infection, which recovered with 1-week oral antibiotic treatment in 3 patients, and no patients developed nerve problems.

Discussion

Axial fixator is often used especially in the treatment of humerus shaft fractures depending on the injury, patient morbidity-mortality, and fracture type. We achieved successful results with axial fixator treatment, which we used to treat humerus shaft fractures, in our study in patients who had gunshot wounds, comorbid problems due to advanced age, multisystem injury, and open fractures. We obtained similar results in patients with comorbid problems because of advanced age and in other patients.

External fixator is used more frequently in orthopedic surgery with each passing day. The advantages of it are not requiring surgical incision, less damage to soft tissues, opportunity of dynamization, and allowing natural union [6]. Although union rates were reported to be lower in previous studies in humerus shaft fractures, 89-100% union rates are reported in recent studies with increased experience and implant development [7]. The mean union time varied between 11-24 weeks in these studies. In our study, we did not require additional surgical procedures because union was achieved in 26 patients (86.7%). We achieved union in 13.7 weeks on average. Union rates were similar in

Table 1. Demographic features of study group.

Gender (Male/Female)	17 (56.7%) / 13 (43.3%)
Side (Right/Left)	14 (46.7%) / 16 (53.3%)
Age	54.43±17.6
Injury Mechanism-Fracture Type	
Gunshot Wound	2 (6.7%)
Multisystem Injury (High energy trauma)	4 (13.3%)
Open Fracture	8 (26.7%)
Patients with Advanced Age Comorbidity	14 (46.7%)
Other	2 (6.7%)

Data are given as mean ± standard deviation / Median / Minimum-Maximum or frequency, percent.

Table 2. General characteristics of study group.

Variables	Total	Young Patients	Elderly Patients	*p*
DASH scores	22.1±7.9	21.9±7.3	22.4±8.9	0.436
Scope Shot	9.5±2.5	9.0±0.9	10.0±3.6	0.158
Surgery Duration (min)	26.7±12.0	28.0±14.0	25.2±9.6	0.264
Union of fracture (week)	13.7±3.2	12.8±3.2	14.9±2.9	0.036
Reoperation	4 (13.3%)	2 (12.5%)	2 (14.2%)	

Data are shown as mean ± standard deviation / Median / Minimum-Maximum or frequency, percentage.
p: Independent sample *t*-test or chi-square test was used.
p: Comparison between subjects

our study to previous studies in the literature. Union times were higher than in studies in the literature. We believe that these high rates occurred due to the differences in age and indication distribution in the patients who were included in our study. In our study, 46.7% (14 patients) had high comorbid conditions over the age of 65. In fact, when these patients were compared with other patients, the union times were long because the potential for union was low in patients over 65 years of age. When we compared patients with gunshot wounds, open fractures, or multiple injuries, we found similar union rates. These results achieved in our study show that external fixator can be applied with the same safety and success in patients who have closed fractures and high comorbid conditions over the age of 65, as in similar age group and similar inductions reported in the literature.

In previous studies, complication rates of 8-36% were reported. Deep infection, pseudoarthrosis, and faulty union are common complications reported in previous studies [8]. In our study, 3 patients developed a superficial infection, which recovered with oral antibiotic treatment for 2 weeks and pseudoarthrosis in 4 patients. We had a low rate of complications in our study when compared to others, such as the recent study conducted by Azevedo et al. [7]. We believe that this may be because of the developing implant technology and accumulated experience.

Many methods have been described in the literature for the treatment of humeral shaft fractures. Many authors have reported that union is easy in humeral shaft fractures, and many conservative methods have been described showing that simple surgical methods can be used in the case of pseudoarthrosis [9,10]. In the literature, plate-screw fixation, intramedullary nail and external fixators are the main applications in surgical methods. Different success rates have been reported with these methods [11-13]. Many studies using plate and screw osteosynthesis have reported union rates of 96% and 100% [13]. Union rates in patients with anterograde intramedullary nails are 71-100% [14]. Patients had gunshot wounds, open fractures, pseudoarthrosis after conservative treatments, or elderly patients with high morbidity and surgical indications were included in our study. For this reason, we applied Axial External Fixator Treatment to our patients, which we believe to be the simplest surgical procedure and in which we had high clinical experience. We achieved boiling rates almost the same as in open surgical methods in our patients.

External fixators, which were considered not to produce full stable reduction in emergency fracture fixation such as open fractures and multi-system injury patients in the past, are now used in simple closed fractures with the increased experience and developments in implant technology providing union rates similar to open methods with more stable fixation [7]. It is considered to cause less damage to the surrounding tissue, provide recovery of fracture hematone with less surgical duration contributing more to fracture recovery [7]. In this context, we believe that this will provide effective fracture recovery in external fixators when stable fixation is achieved with increased experience and appropriate implant selection. In this respect, as well as external fixator indications reported in the literature, we applied external fixators to elderly patients who could not be improved by closed methods or who had surgical indications. We achieved 86.7% union in these patients; and found no differences between the union rates of this group and the union rates of other patients. For this reason, we believe that this method is an applicable method in these patients.

The retrospective study design, lack of a control group, limited number of patients, and short follow-up times were among the limitations of the present study. Studies with more patients and higher effect size are required in this respect.

Conclusion

External fixator (EF) treatment is less invasive than other surgical treatment methods and the surgical time is shorter. EF treatment is a surgical method that is frequently applied in open fractures seen in high-energy traumas such as firearm injuries and traffic accidents. In conclusion, we think that it is a more appropriate surgical technique than other surgical methods, due to its shorter surgical time and less

invasiveness in patients with advanced age, high comorbidity and multisystem damage.

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Conflict of interest

There are no conflicts of interest to declare.

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